5. WORKING THE PROCESS: BUILDING AN APPROACH FOR COMMUNITIES TO UNDERSTAND THE ECOLOGICAL RISKS, COSTS, AND BENEFITS OF WATER QUALITY MANAGEMENT DECISIONS

In this report, we describe a process for WQS that is designed to help decision-makers understand the full environmental, economic and social implications of alternative water quality goals. It emphasizes community involvement throughout the decision process and provides a general framework for evaluating the relevant gains or losses. Each of the previous chapters played a specific role in describing and developing the decision process. For example, we connected the process to the analysis of whether attaining the use is "feasible" under 40 CFR 131.10, or whether changing the current use in an AR is necessary for important economic or social development under 40 CFR 131.12(a)(2). Questions that may trigger the process for a UAA might be what are the benefits of attaining a use that is not currently being attained? Or, for an AR, the relevant question might be, if we allow the degradation being considered, what are the damages (e.g., lost ecological benefits) produced? Because the process required complying with the current regulatory framework, we introduced the CWA and WQS regulation in order to provide some context (Chapter 2). To link use-attainment decisions and their effects on ecosystems, we suggested using expanded conceptual models based on concepts from ecological risk assessment, stressor identification, and socioeconomic analyses (Chapter 3). Finally, we described and compared various social science methods that could either provide quantitative or qualitative information to support the decisions (Chapter 4).

The purpose of this chapter is to provide a concise description of how the proposed approach can be implemented in practice, using the methods and tools described in the previous chapters. The decision process is illustrated again in Figure 5-1. This figure outlines the same steps described in Figure 4-1; however, it emphasizes three main phases: (1) framing the WQS decision, (2) comparing the advantages and disadvantages of the different management options, and (3) making the decision (selecting the option).

This chapter is organized according to these three phases. For each phase, it describes the main components of the process and the techniques that can be used to address each component. It also uses two of the hypothetical case studies described in Chapter 3—the combined sewer overflow (CSO) example and the acid mine drainage (AMD) example—to illustrate specifically

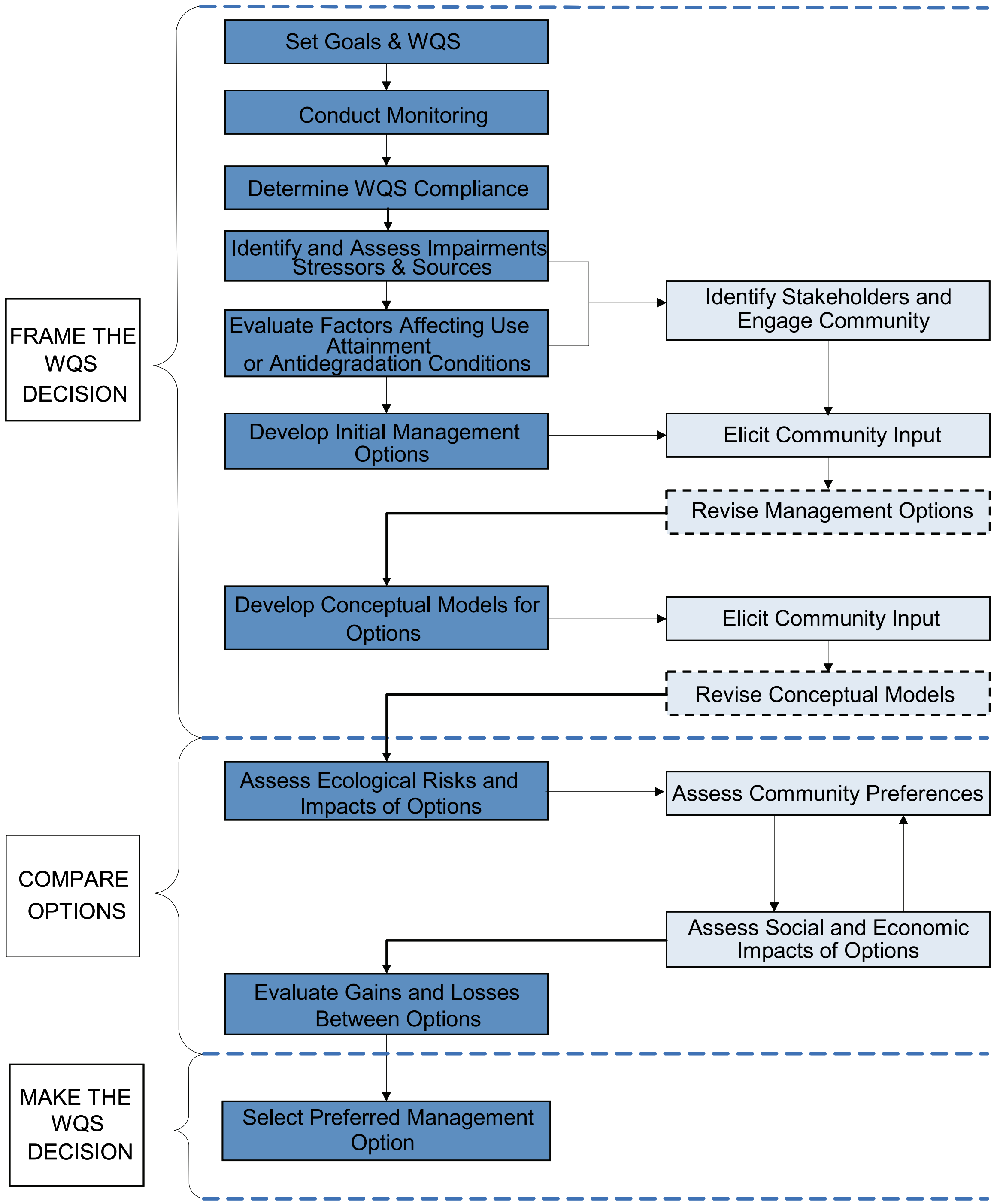


FIGURE 5-1

Three Phases of the Decision Process Framework how the methods and tools described in the previous chapters can be applied to inform and strengthen each stage of the decision-making process.

The proposed decision process described in Figure 5-1 and the example applications described in this chapter were developed using input from invited participants who attended a workshop sponsored by U.S. EPA/Office of Research and Development/National Center for Environmental Assessment on November 14–15, 2006. The objectives of the 2-day workshop were to (1) critically examine and develop recommendations for revising an earlier draft of this report (Chapters 1 through 4), (2) employ hypothetical case studies of use-attainment problems to evaluate a draft decision process and (3) hold discussions with practitioners and stakeholders to develop recommendations for incorporating community preferences into water quality management decisions. The workshop brought together 20 experts from various parts of U.S. EPA, from state and local organizations, and from RTI International.[1] A roster of participants and the workshop agenda are provided in Appendix C. It is important to emphasize that the decision process and methods described in this chapter represent the authors' best efforts to incorporate a wide variety of recommendations and opinions expressed during the workshop; however, they do not necessarily fully reflect the views of each participant.

5.1. FRAMING THE WQS DECISION THROUGH COMMUNITY INVOLVEMENT

As illustrated in Figure 5-1, the first phase of the decision process involves framing the relevant decision. This means identifying the key water quality impairments, along with the related sources and stressors, and determining the set of feasible options available for addressing the impairment. It also means recognizing and engaging community residents in initial discussions of how they are likely to be affected by both the impaired water and the options available for addressing the impairment. As discussed below, group deliberative methods can be used in several ways to involve the community in framing the decisions, including (1) identifying community priorities, concerns, and constraints; (2) revising and defining the most practical set of management options; and (3) revising and finalizing conceptual models that illustrate the key linkages between environmental conditions and human welfare and the gains and losses involved in the decision-making process.

[1] RTI International is a trade name of Research Triangle Institute.

5.1.1. Identifying Key Stakeholders and Engaging the Community

Involving community stakeholders early in the decision-making process using deliberative approaches can help identify and explain unexpected barriers or benefits to specific management options. It also can begin the important process of establishing a rapport and gaining the trust of community residents and stakeholders. This initial stage of community involvement can be a two-way communication process whereby decision-makers introduce the WQS problem and decision-making process to the public and residents in turn can provide information on local conditions, priorities, and perspectives. By selecting a broad base of community representatives early in the process, decision-makers can make the WQS process more acceptable to the community as a whole and engage those who may feel less informed about or less qualified to address the issues at hand. At this stage, rather than recruiting specific stakeholder input from the community, decision-makers should be providing an organized and accessible conduit for decision-makers and community members to introduce themselves and present their perspectives going into the process. The level of public participation is likely to vary throughout the process; therefore, this initial stage can serve to identify stakeholders who are particularly invested in the WQS decision and who are most likely to play an active role in subsequent stages of the process. It also can help identify issues of particular concern to all community residents.

5.1.1.1. *The AMD Case Study Example*

In this hypothetical case study example, which is described in detail in Section 3.4.3.1, drainage from abandoned surface mines has caused serious impairments in 3 miles of a tributary stream and 8 miles of a river. These impairments have reduced the size and variety of ecological services available from these water bodies, in particular recreation and aesthetic services for local residents and for recreational boaters, hikers, and anglers. For reasons described in Chapter 3, the focus of the UAA is on options that control AMD discharges to the tributary.

Even before an initial set of management options has been defined, group deliberative methods can be used to engage the community and to begin framing the decision in a way that is understandable and hopefully acceptable to the affected community. In this case, the main stakeholders are likely to include local landowners, recreationists, watershed protection groups, local government, and local businesses.

Because the affected geographic area and the size of the immediately affected population are relatively small, holding one or two public meetings within the local community may be adequate as an initial step. These meetings, which by definition are open to the public, can be used in several ways. First, they can be used to present the findings of environmental and ecological assessments to the community. The information conveyed in this setting would include descriptions of the AMD sources, the types of water quality impairments resulting from these sources, the requirements and goals of the WQS program in relation to these impairments, and the factors affecting use attainment. Second, the meetings would provide stakeholders with an opportunity to identify themselves, to state their own objectives and concerns, and to provide their own perspectives and knowledge regarding the AMD-related impairment. For example, it might allow local land and business owners to describe their main experiences with AMD-related impairments and what their expectations are regarding clean up. Third, public meetings can be used to identify individuals who are willing and best positioned to serve on an advisory committee. In this case, one or two individuals from each stakeholder group might volunteer or be selected to serve as representatives on the committee, which would have a more regular and active role in the next phases of the decision-making process.

5.1.1.2. *The CSO Case Study Example*

In this hypothetical case study example, which is described in detail in Section 3.4.3.2, the water quality of a large river is impaired by pollution for CSOs. An interstate Basin Commission is responsible for improving water quality of this river, which flows through multiple states and is currently not attaining water quality standards for primary contact recreation during wet weather. The Basin Commission must determine the best way to address the nonattainment of the designated use. First, stakeholders and other interested parties should be identified. Stakeholders include those who use the river for recreation, derive a value from the existence or aesthetics of the river, and/or would be affected by higher sewer rates. Potential stakeholders include local communities, recreationalists, states, local businesses, economic development groups, and watershed groups. Public meetings could be used to inform stakeholders of the problem, to present potential solutions, to obtain feedback about the options, and to begin to determine community preferences. The location and announcement of these meetings should be targeted toward key stakeholder groups, and the meetings should be easy for them to attend and offer a variety of methods for providing their input. It is important to determine if the meeting is successful at getting information from the targeted stakeholders. If not, other methods should be considered to reach the stakeholders who were not represented.

5.1.2. Identifying and Defining the Most Relevant Management Options

Community residents' knowledge of local conditions and resource uses can be invaluable in the initial process of refining the prospective management options for application in a specific setting. Specialized knowledge of local conditions and constraints (both physical and social) may help decision-makers in an initial assessment of the management options. First, community residents can identify barriers that preclude the application of certain management options. These may include local conditions, patterns of resource use, or just strongly held local attitudes. Second, community residents can identify factors that might facilitate the use of certain management options with minor adaptations to better fit the local conditions or needs of the community. Finally, community residents can identify completely new management options.

As with the prior phase in the WQS process, the deliberative methods described in Chapter 4 are particularly useful for eliciting input from the community regarding the various management options under consideration. The deliberative process has the added advantage of providing decision-makers with key insights into underlying values and perspectives that shape the preferences expressed by community residents, which are discussed further in Section 5.2. Analytical approaches could play an important role at this phase, for example, if the management options are particularly complex or community residents are unable or unwilling to arrive at a workable consensus in participatory formats.

5.1.2.1. *The AMD Case Study Example*

In this case study, the state has initially determined, based primarily on environmental and engineering analyses, that two main management options are available for addressing the AMD-related impairments to the tributary and the river—a limestone channel or a constructed wetland. Before assessing community preferences for these options, it may be useful to use group deliberative methods to acquire other types of community input (see Table 4-1). For example, through their participation in an advisory committee (Section 4.10), individuals with specialized knowledge of local conditions may be able to suggest adaptations of the limestone channel that would make it less of an eyesore to local homeowners. Similarly, they might be able to identify ways of adjusting the placement of the wetland that would increase its attractiveness to local recreationists, without decreasing its effectiveness for addressing AMD discharges.

5.1.2.2. *The CSO Case Study Example*

Based on an assessment of sources, stressors, and impairments and factors affecting use attainment, and with initial input from the community, the interstate Basin Commission described in this case study proposed two feasible alternatives to address nonattainment of the river for primary contact recreational use. Option 1 will attain the primary contact recreational use eliminating 95% of the CSO structures, in addition to other upgrades with an estimated three-fold increase in sewer rates. Option 2 will attain a wet weather limited use subcategory for primary contact recreation by eliminating 75% of the CSO structures; this would require a 50% increase in sewer rates.

At this stage, group deliberative techniques could be used in several ways to elicit input from the community on the set of feasible management options. For example, public meetings (Section 4.5) with local communities and watershed groups might lead to suggestions for ways to reduce stormwater flow, which would decrease the number of CSO events and improve water quality. Such reductions might be accomplished by residents installing rain gardens and/or cisterns to capture runoff from their roofs during storm events instead of allowing it to flow into combined sewers. This option would require widespread implementation to be effective and would not address runoff from roads and commercial and industrial properties.

Similarly, public meetings involving local businesses and economic groups might lead to additional options, such as an off-line underground storage facility that could store excess runoff during storm events and be released for treatment during dry weather. These groups might believe that this type of option would cause less disruption of service/business and also might achieve the 75% reduction in CSOs.

To examine the feasibility of the proposed options, the Commission could then form an advisory committee, based on the groups represented at the public meetings (and any additional groups that were identified). This committee could, for example, include representatives from the local communities (residents and businesses), state governments, and water quality scientists.

5.1.3. Developing and Refining Conceptual Models of Management Options

In this phase of the WQS process, the specialized knowledge offered by community residents may help decision-makers refine the conceptual models of the various management options under consideration. These diagrams depict, in qualitative terms, the fundamental relationships between pollution sources, ecosystem processes, and human welfare, and they illustrate how the management options alter these relationships (see Section 3.4). Thus, they frame the main gains and losses involved in selecting between management options. By including resident knowledge and perspectives on local aquatic resource use and preferences, community participation in refining these models could, for example, provide unexpected (to the decision-makers) linkages between ecosystems and ecosystem services.

Decision-makers also might find the perspective of community residents useful in identifying ways to employ a simplified version of the conceptual models as a decision aid. A simple conceptual model clearly illustrating the linkages between stressors, aquatic ecosystems, and ecosystem services and the consequences of the various management options on those linkages could help community residents conceptualize and compare the available management options. Decision-makers can elicit comments and questions from community residents serving as members of advisory committees or boards to develop simple conceptual diagrams for use in community hearings or in other venues with large numbers of residents and stakeholders. Thus, these stakeholders can assist in eliciting broader community preferences for the options available.

For this phase of the process, both deliberative and analytic sociocultural methods can be used (see Table 4-1). Deliberative methods can elicit specific input from community residents on the diagrams' utility. Analytic methods can be used to review comments and questions offered by participating residents to identify potentially problematic components of the diagrams for revisions or modification.

5.1.3.1. *The AMD Case Study Example*

In this example, it is assumed that, after input from the community, the two primary management options are adapted versions of the limestone channel and the constructed wetlands. These revised options are the ones described in Section 3.4.3.1. One of the benefits of a deliberative process for revising and refining these options is that it provides members of the community (in this case, the advisory committee in particular) with an opportunity to further familiarize themselves with the sources, stressors, ecological impacts, and use-attainment conditions on the tributary and the river and with the expected changes that would occur with the two management options. Using this gained understanding, the advisory committee would then also be well positioned to participate in developing and revising the conceptual models.

Figures 5-2 through 5-7 illustrate how the conceptual models for this case study can be constructed in stages, using input from the advisory committee. Building these diagrams gradually through a participatory process with community representatives offers several advantages, including the following: (1) it takes advantage of the participants' understanding of local conditions and (2) it provides models that are easier for the lay public to understand. For example, Figure 5-2 provides a simple representation of the current conditions at the case study site. It identifies the main sources of impairment, the stressors, the affected ecosystems, and the linkages between them. This type of flow diagram, combined with the physical representation of the site, could be initially developed by water quality experts and presented to the advisory group as a way of generating discussion, eliciting feedback, and establishing a common understanding of the main water quality problem to be addressed. The deliberative process could then be used to revise and expand the model. As shown in Figure 5-3, input from community representatives could be used to identify and represent the main ecosystem services affected, and water quality managers could use the diagrams as a way of illustrating to these participants the key designated use impairments. Diagrams for the management options also could be constructed in a stepwise fashion, as shown in Figures 5-4 to 5-7. For instance, water quality managers and engineers participating in the project could use the diagrams to illustrate for other participants how the limestone channel and the constructed wetland would affect the flow of stressors from the AMD sources, and they could use the diagrams to describe the expected costs of the options and their expected implications for designated use attainment on the tributary and river. Then, through deliberations with the community participants, they could identify and add to the diagrams the

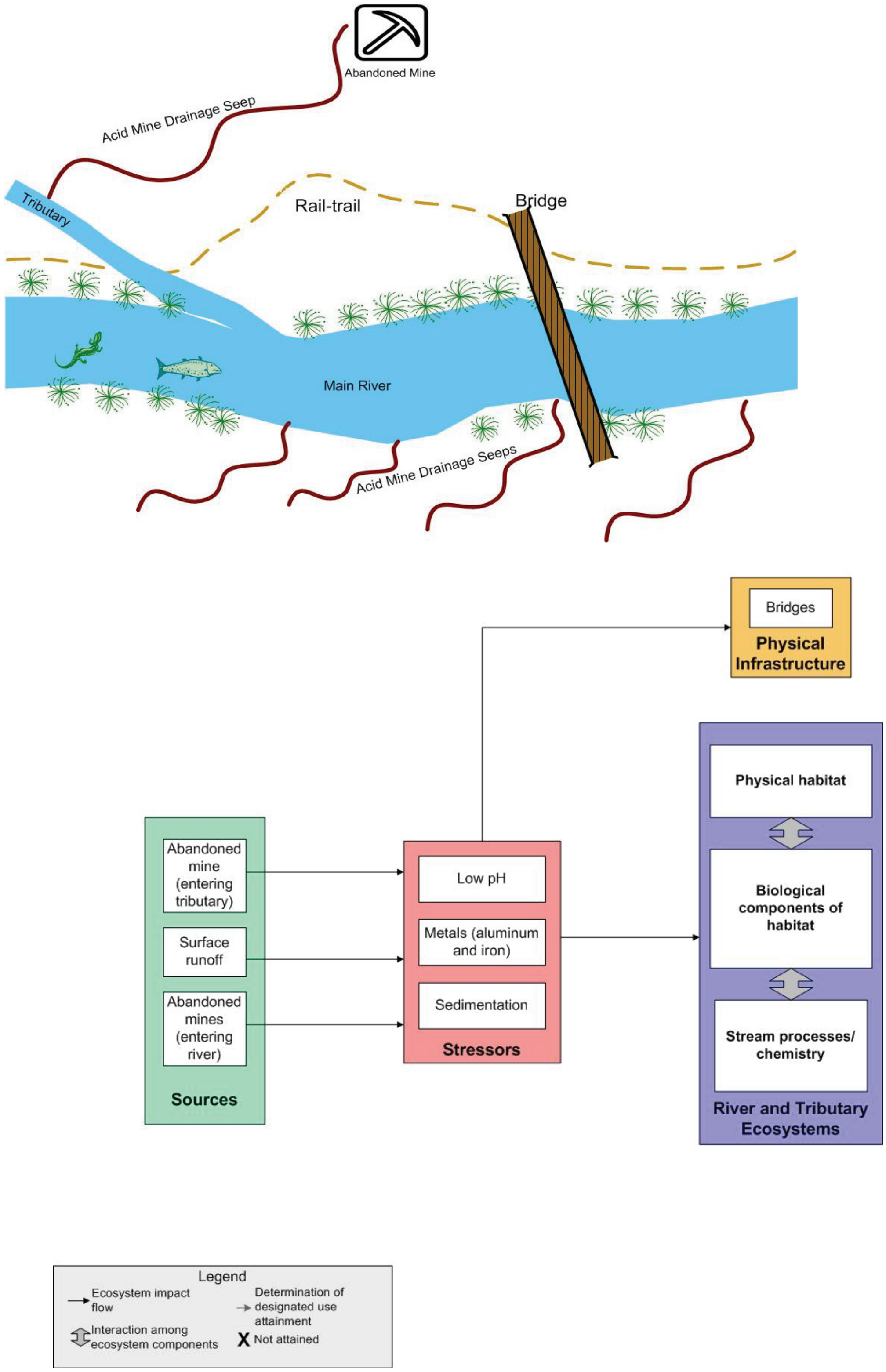


FIGURE 5-2

Mitigating Acid Mine Drainage Impacts on a Tributary and River:
Current Conditions (Version 1)

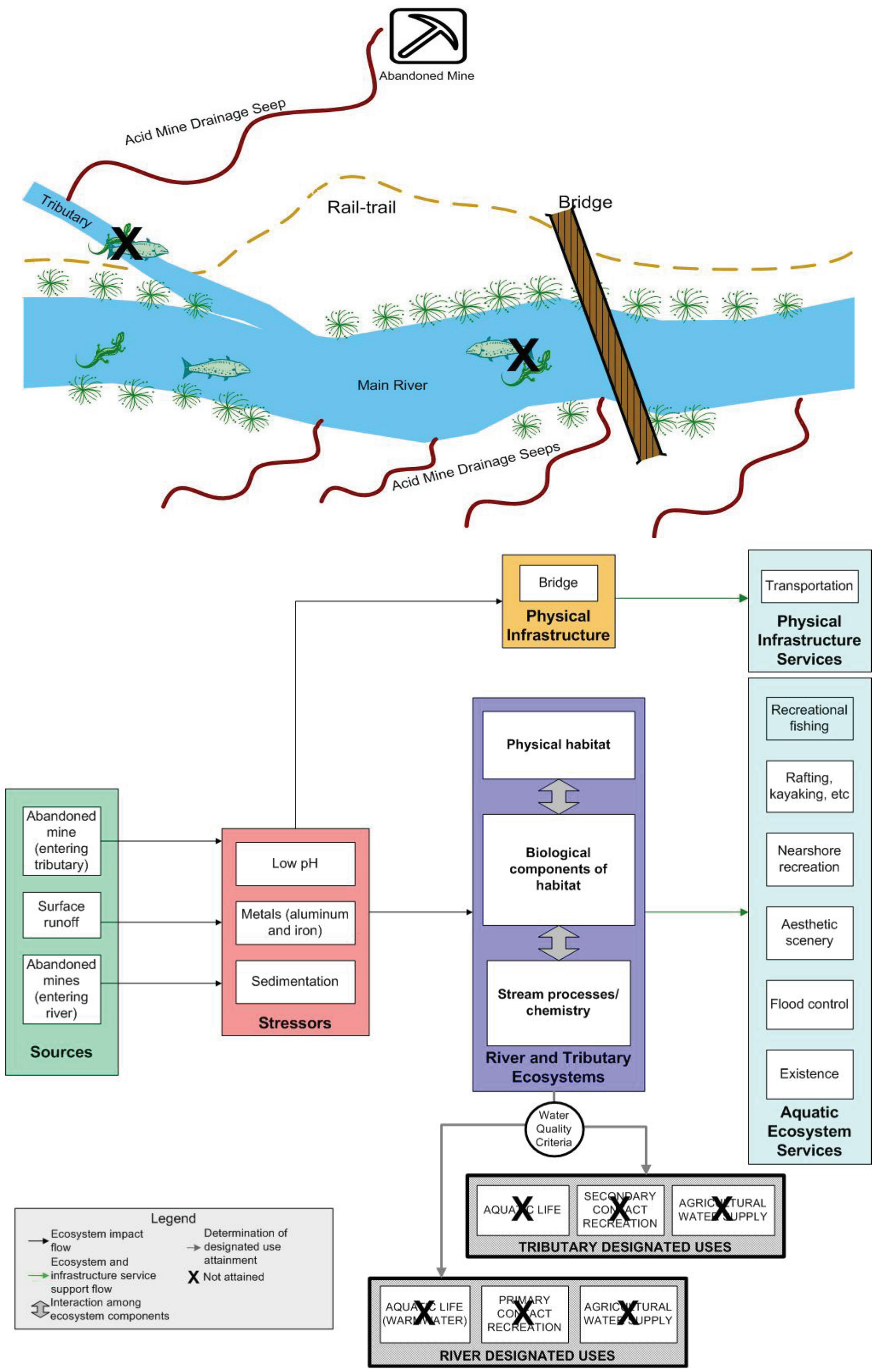
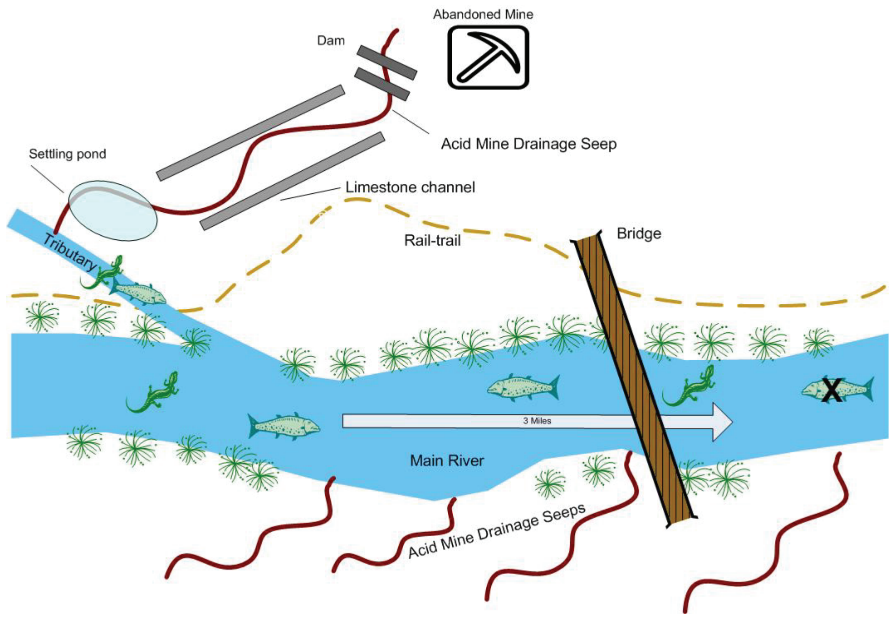


FIGURE 5-3

Mitigating Acid Mine Drainage Impacts on a Tributary and River: Current Conditions (Version 2)



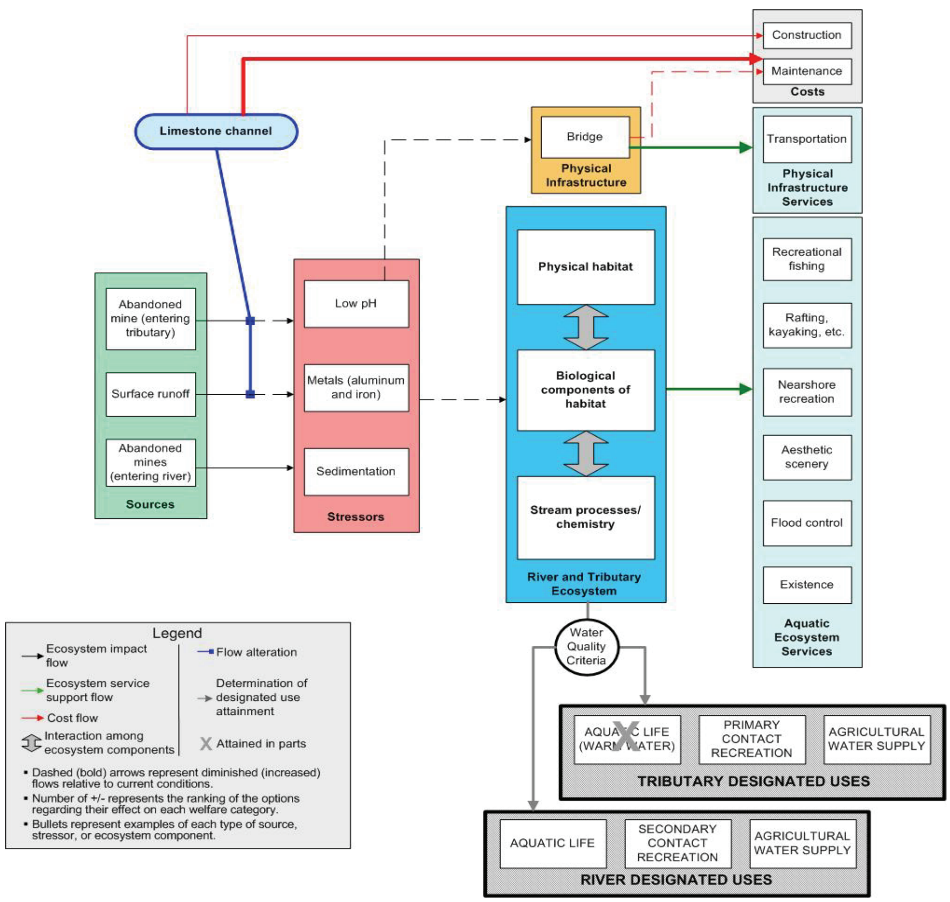


FIGURE 5-4

Mitigating Acid Mine Drainage Impacts on a Tributary and River
Option 1: Create Limestone Channel (Version 1)

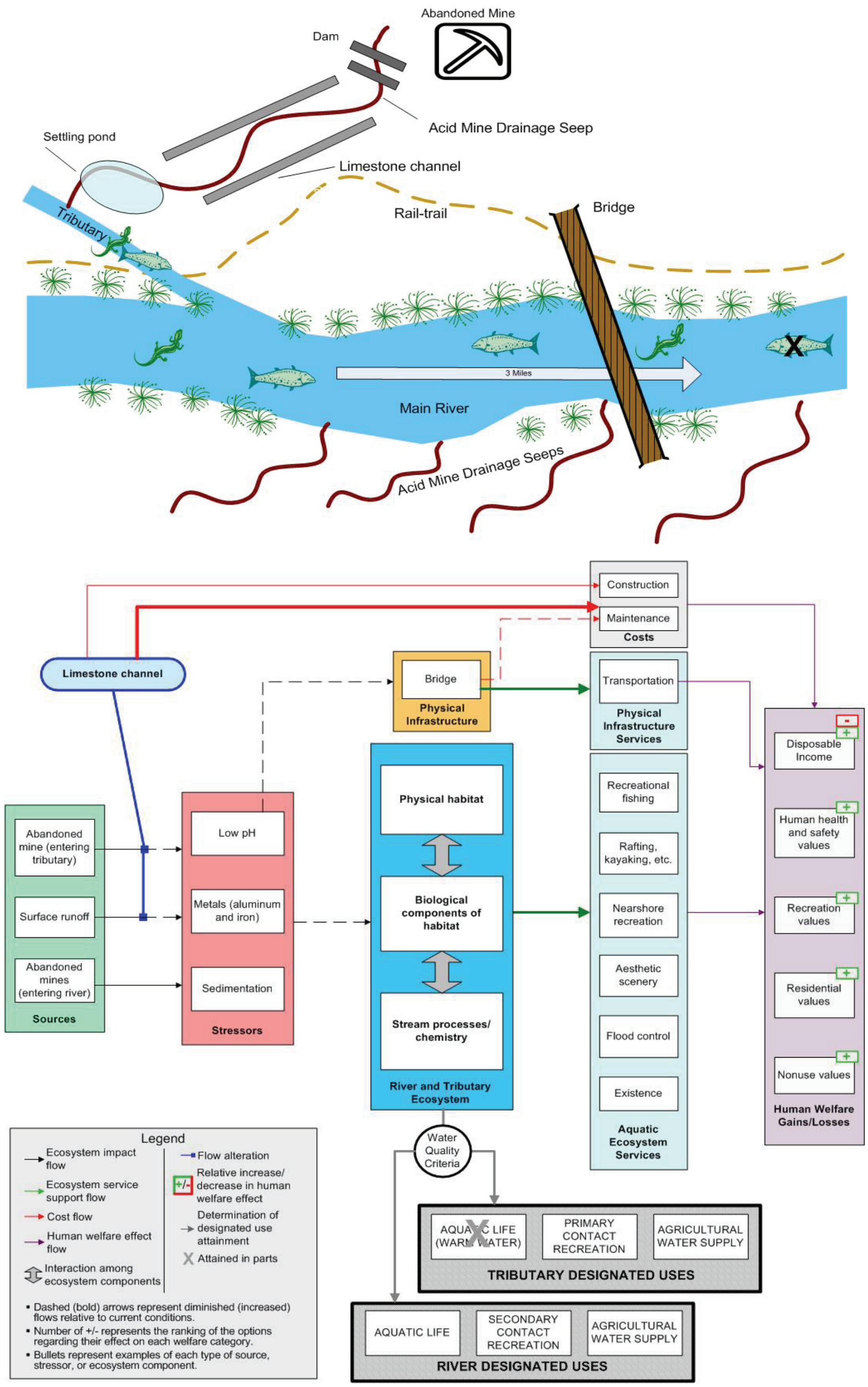
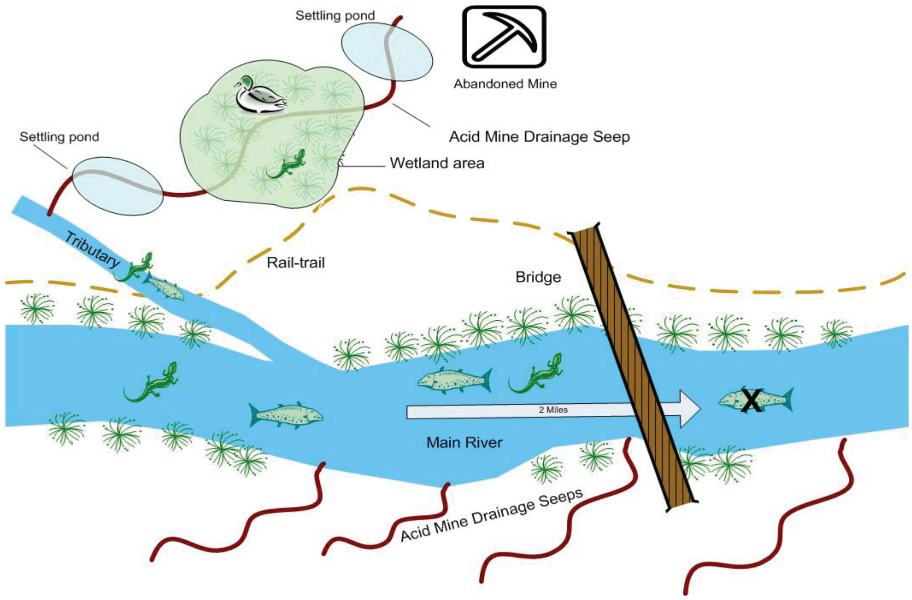


FIGURE 5-5

Mitigating Acid Mine Drainage Impacts on a Tributary and River
Option 1: Create Limestone Channel (Version 2)



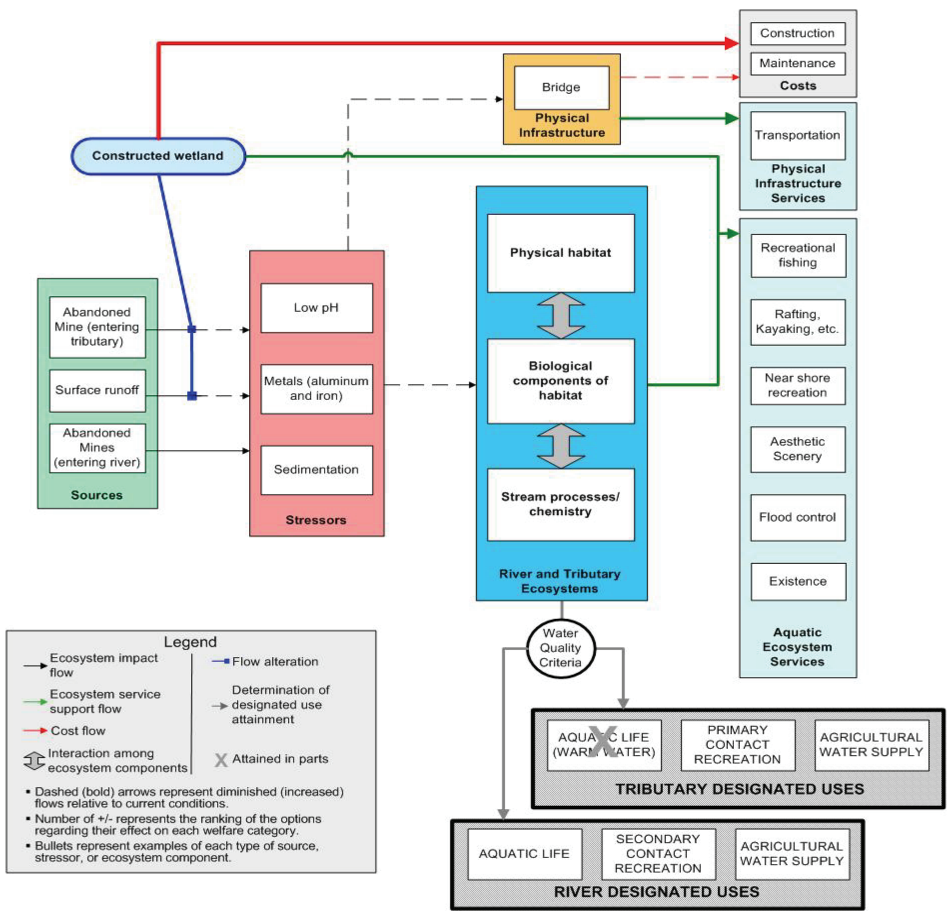


FIGURE 5-6

Mitigating Acid Mine Drainage Impacts on a Tributary and River
Option 2: Create Wetland Area (Version 1)

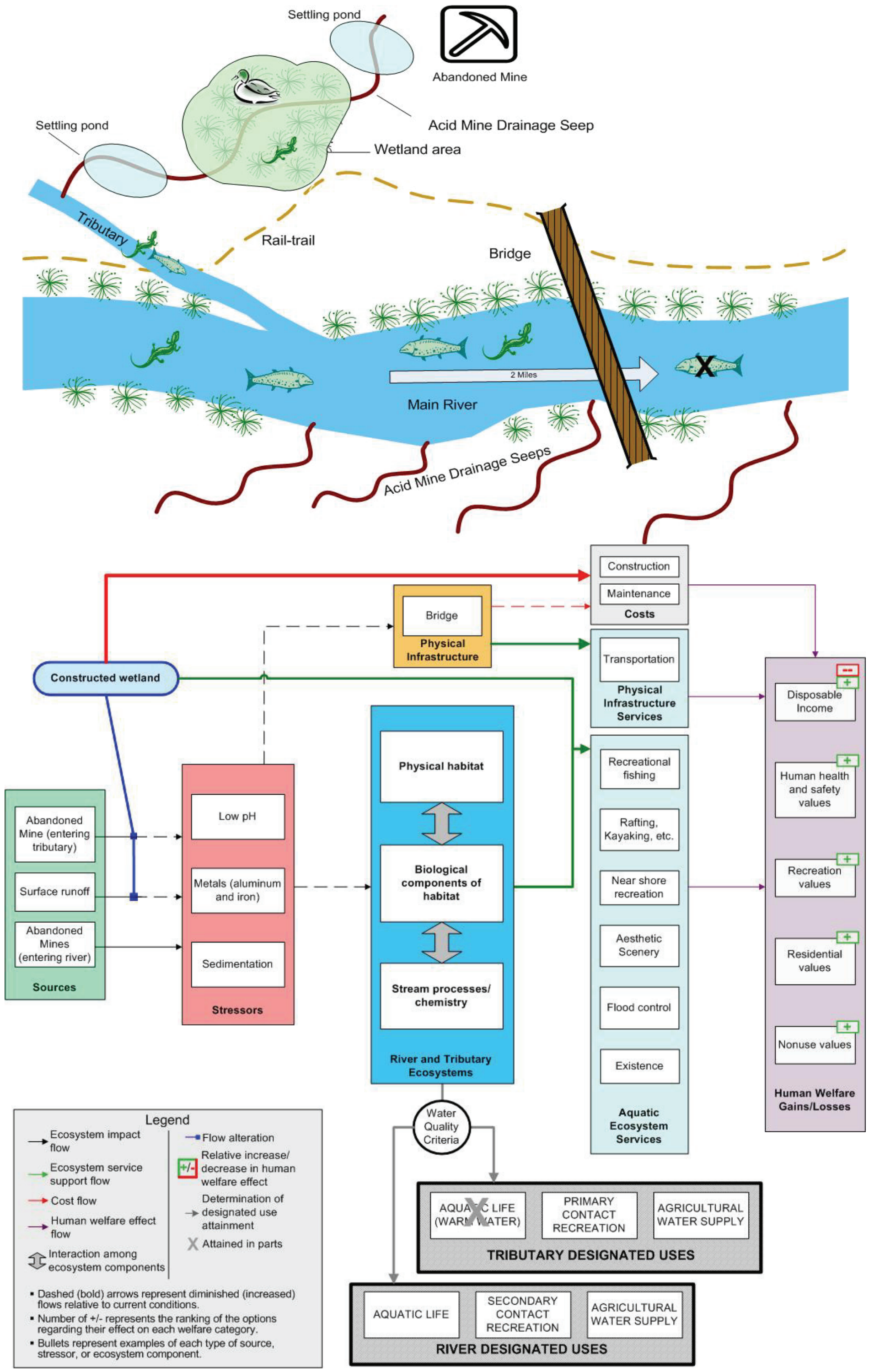


FIGURE 5-7

Mitigating Acid Mine Drainage Impacts on a Tributary and River
Option 2: Create Wetland Area (Version 2)

main human welfare gains and losses expected to result from the two options (Figures 5-5 and 5-7).

At this stage, compared with the diagrams reported in Section 3.4 for this case study, the diagrams in Figures 5-2 through 5-7 include less detail regarding the complex relationships between sources, stressors, aquatic ecosystems, ecosystem services, and human welfare changes. Thus, these intermediate-level diagrams may be useful as tools for communicating the water quality management problem to the broader public in the affected community. Parts of these diagrams could, for example, be used in public meetings as a way of walking the community through the issues and trade-offs involved in addressing the AMD sources and as a way of eliciting further feedback from the public. In contrast, the more detailed and complex diagrams shown in Figures 3-5 through 3-7 could be developed through further deliberations with the advisory panel and with other experts, such as ecologists and economists. These detailed conceptual models are likely to be most useful for the water quality managers as a way of framing the decision problem.

5.1.3.2. *The CSO Case Study Example*

In this example, the Basin Commission presented two primary management options focused on developing a special wet weather use category for primary contact. These options are described in Section 3.4.3.2. As in the AMD example, one of the benefits of this process for revising the options is to provide stakeholders an opportunity to understand the sources, stressors, and ecological impacts of the options. In this case, the process provided the Commission with an opportunity to learn about localized efforts that could contribute to the solution and allowed stakeholders to feel ownership in the problem and the solution.

With input from the advisory committee, it is possible for the Basin Commission to develop conceptual models that incorporate the knowledge and perspectives of the affected community. Using a similar stepwise procedure as the one described above for the AMD case study, the advisory committee, including stakeholders and water quality experts, could participate in the process of developing the conceptual models shown in Figures 5-8 through 5-10. By constructing these models collaboratively, water quality managers and stakeholder representatives can evaluate all of the proposed options to determine how applying them would address stressors, the river ecosystem, and eventually the designated uses of the river. The

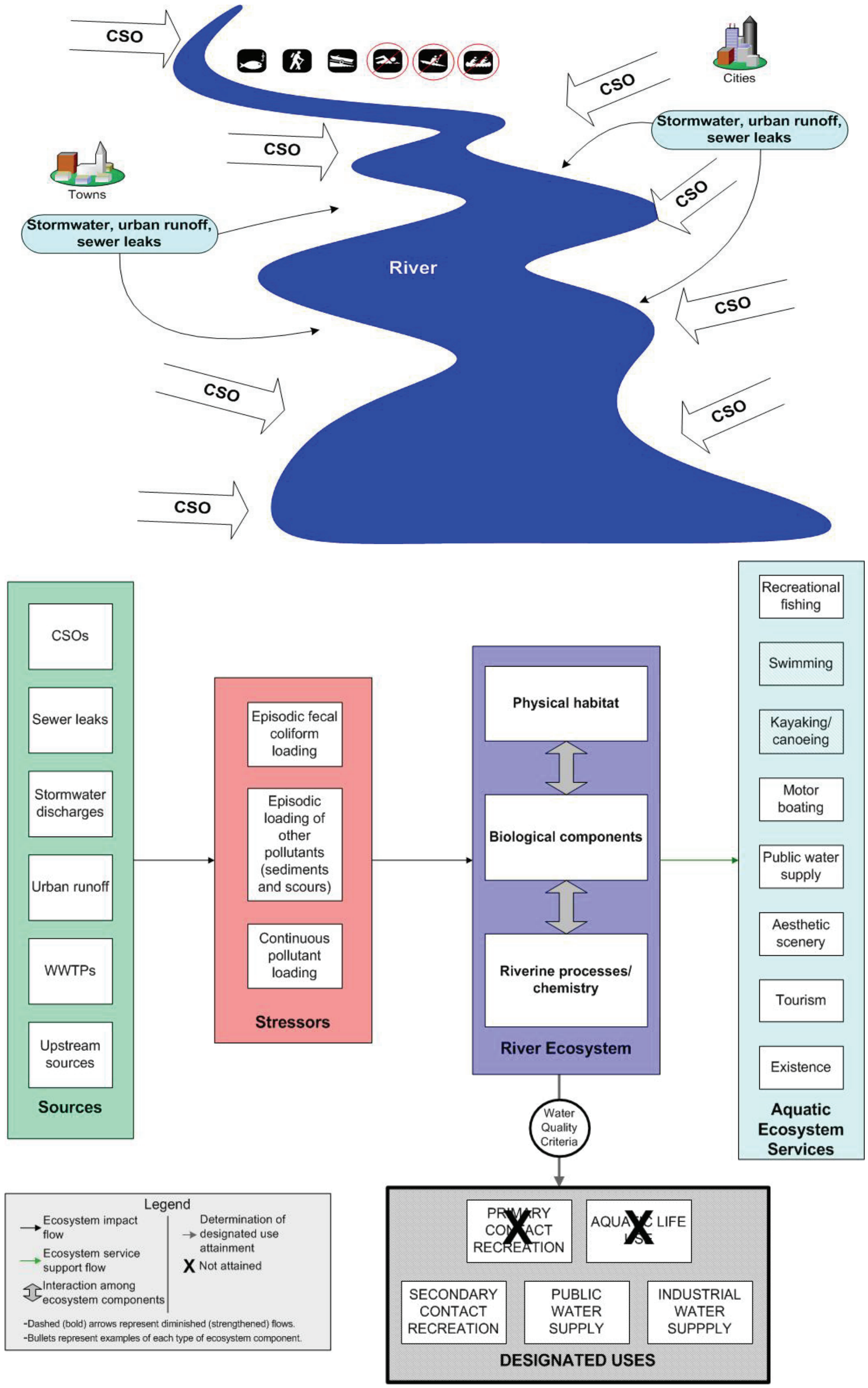


FIGURE 5-8

Mitigating CSO and Stormwater Impacts on a River System:
Current Conditions

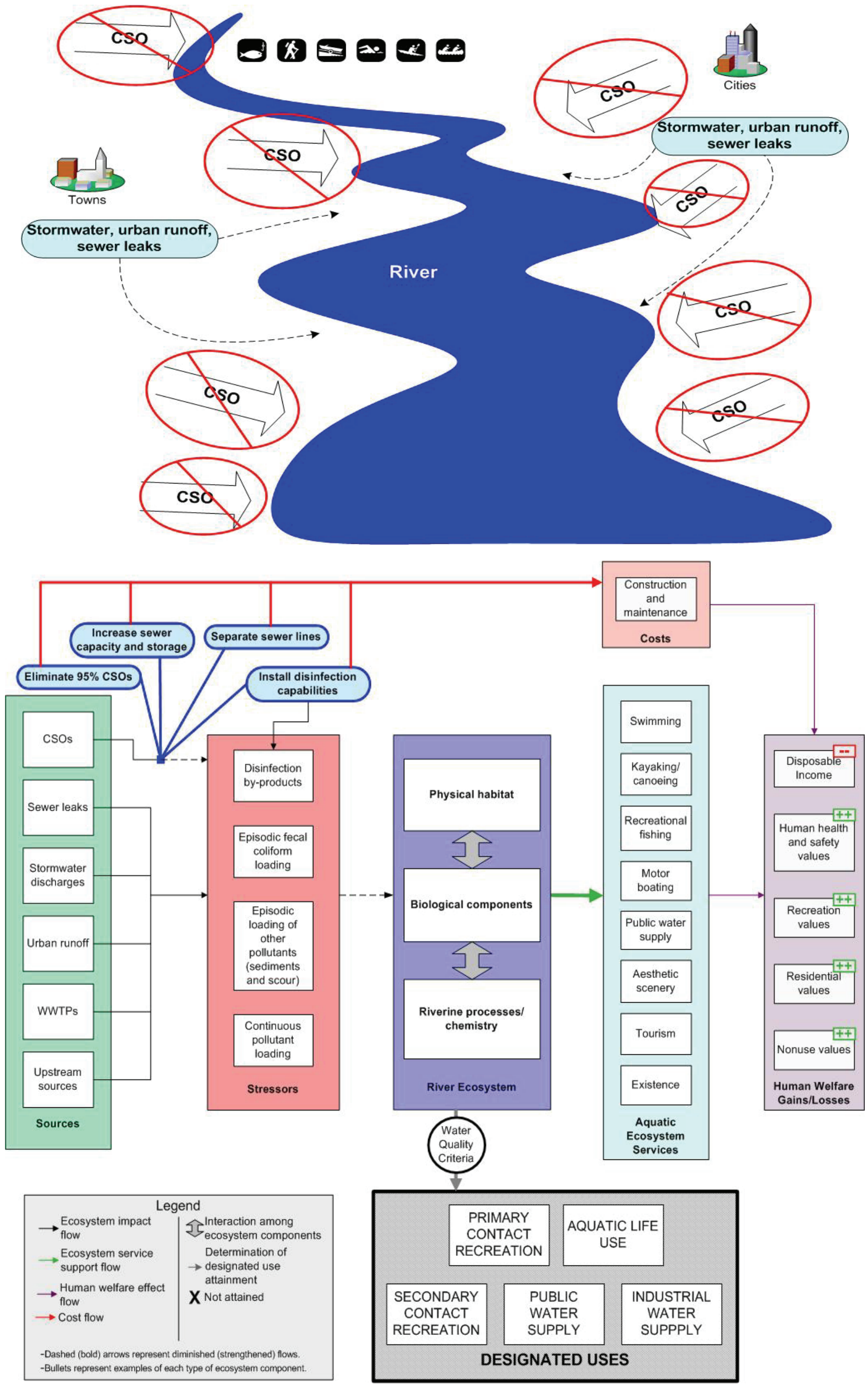


FIGURE 5-9

Mitigating CSO and Stormwater Impacts on a River System
Option 1: Eliminate 95% of CSOs and Implement Other System Improvements

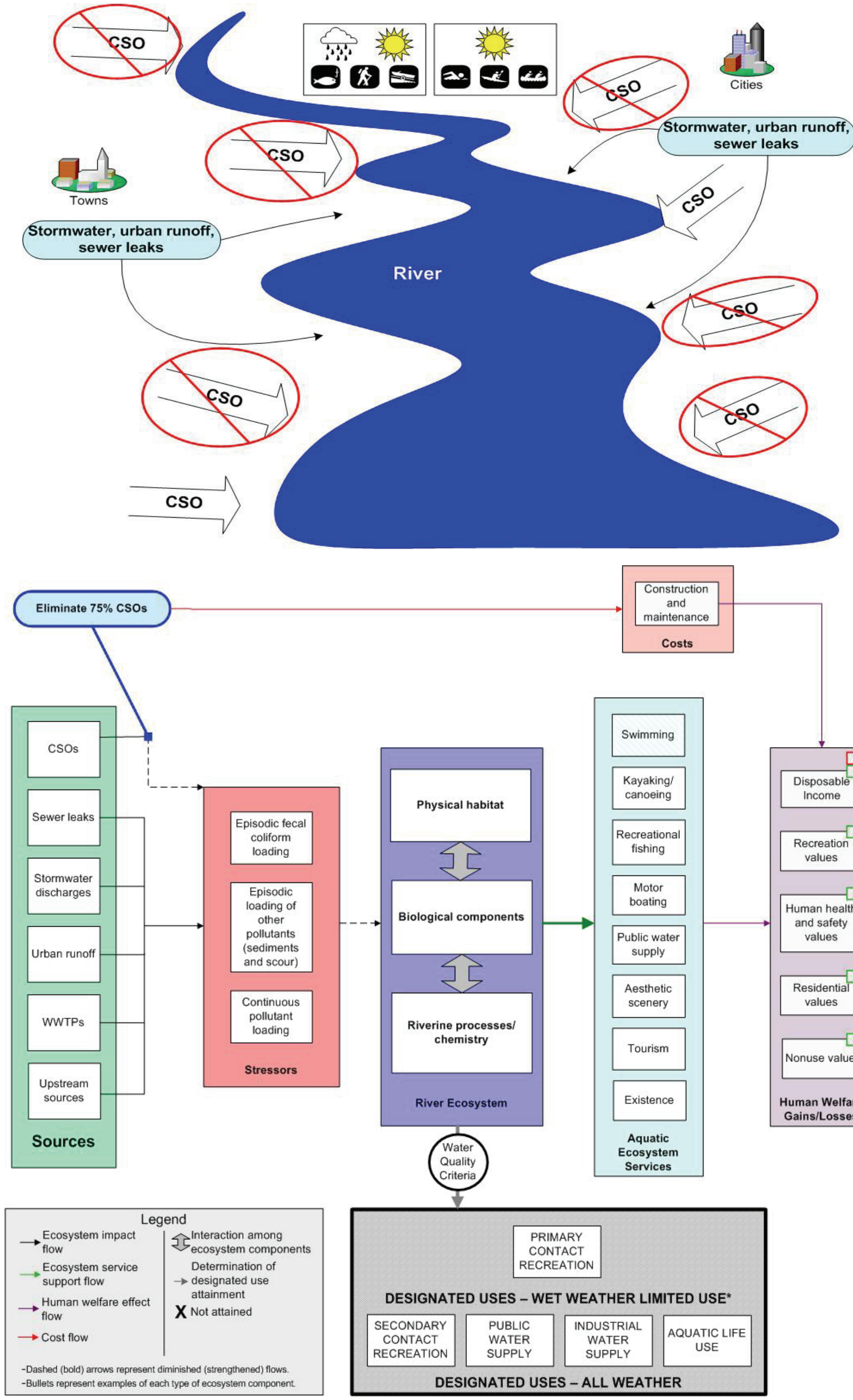


FIGURE 5-10

Mitigating CSO and Stormwater Impacts on a River System
Option 2: Eliminate 75% of CSOs and Apply Limited Use Designation

participation of the advisory panel can help ensure that all ecosystem services and human welfare effects are accounted for in the framework. Working with water quality experts, they also can help identify the main stressors and their impacts on the river ecosystem.

The process of assisting with the development of the conceptual models could also help members of the advisory panel better understand the relevant gains and losses. For example, the process might help clarify for them what the additional costs of Option 1 would provide to the community in terms of improved health and recreational services. The resulting intermediate-level models shown in Figures 5-8 through 5-10 also might serve as a resource for educating the general public about the WQS issue and the relevant gains and losses.

5.2. COMPARING OPTIONS THROUGH THE ASSESSMENT OF COMMUNITY PREFERENCES AND SOCIOECONOMIC IMPACTS

After the decision has been appropriately framed by determining the main management options and, as appropriate, constructing conceptual diagrams, decision-makers need to evaluate the advantages and disadvantages of the options. In addition to conducting ecological risk assessments for the options and evaluating their respective environmental impacts, the decision process can be enhanced by assessing community preferences. This entails gathering information from the community to assess how different segments of the affected population regard and value different features of the options. Chapter 4 of this report discusses several sociocultural and economic approaches that can be used to elicit or measure preferences. With this information, it is then also possible to estimate the social and economic impacts of the different options. For example, estimates of stakeholders' WTP for different improvements in ecological services can be used to inform a cost-benefit analysis of the options. In other words, the results of the preference assessment can help decision-makers gauge, for each option under consideration, how the overall well-being of the community is likely to be affected. In addition, they can help evaluate how the gains and losses from the different options are distributed across various segments and stakeholders in the community.

As shown in Figure 5-1, the process relating the assessment of preferences and the assessment of economic and social impacts can be an iterative one. Assessing preferences for the options may require some initial understanding of their expected socioeconomic implications. For instance, estimates of how the costs of the management options will be distributed across the community may influence individuals' preferences for the different options; therefore, preliminary estimates of this distribution may help community members better determine and express their preferences.

Regardless of how they are organized, the purpose of all these activities—ecological risk assessment, preference assessment, and the assessment of economic and social impacts—is to acquire and organize information that can be used to evaluate the trade-offs between the options. In some cases, this information may be quantitative estimates of risks, preferences, and impacts, and in other cases, the information may be more qualitative findings regarding the community's attitudes, preference, and concerns. In all cases, however, they should be designed to help decision-makers understand and anticipate the implications of alternative management approaches.

5.2.1. The AMD Case Study Example

In this example, the decision-makers must decide between a limestone channel and a constructed wetland to address the AMD-related impairments of the tributary. Both options also would improve conditions on the river. As highlighted in the conceptual diagrams, this decision requires a careful consideration of whether the additional ecological services provided by the wetland and its lower annual operating and maintenance costs are sufficient to offset the lower capital costs of the limestone channel, along with its ability to reduce impairment on a longer (by 1 mile) stretch of the river.

Given the relatively small scale of this WQS issue (compared, for example, with the CSO case study), a fully quantitative benefit-cost analysis (BCA), particularly one involving extensive primary data collection, is most likely beyond its scope. Nevertheless, a number of less resource-intensive possibilities exist for eliciting and assessing community preferences and using this information to examine the differences between the two management options. In the previous chapter, Table 4-4 identifies several methods that tend to be "low" or "very low" cost compared with other methods. Even though these methods generally provide less detailed information about community preferences, they nonetheless may be informative enough to address the needs of this case study assessment.

One approach would be to conduct focus groups with the advisory panel and with other small groups of local residents and stakeholders. In these deliberative group settings, participants first would be presented with the WQS issue being addressed, the management options under consideration, and the expected costs and ecological impacts associated with the alternatives. Ideally, this presentation would use parts or all of the conceptual model diagrams to help frame the decision context for the participants. Through a structured group discussion, preferably led by a trained focus group moderator, the participants then would be asked to discuss their perspectives on the expected advantages and disadvantages of the options and to indicate the direction and strength of their preferences for one option over another. Because most of this input would be qualitative in nature, the focus group setting also could be used to collect somewhat more quantitative measures of preferences. For example, participants could be asked to rate different dimensions of the options on a numeric scale in a type of opinion survey. They could be presented with a list of affected ecological services and asked to rate their perceived importance of each of these services and the perceived effectiveness of each option in improving these services.

As illustrated in Section 4.9, an inherent limitation of the focus group approach is that the preference information is collected from a small subset of the affected population; therefore, it is difficult to know how well the participants represent the preferences of the broader community. Nevertheless, by including participants from different segments of the population and from different stakeholder groups, these deliberative processes should enhance decision-makers' understanding of where the key concerns lie in the community and which factors are most important in assessing the gains and losses. For instance, the focus groups discussions may strongly suggest that improving local water-based recreation services is paramount for most segments of the community, in which case the comparison of options should focus primarily on how well the two options enhance these services.

Another approach would be to conduct a simplified economic analysis that approximates some of the benefits and costs of the two options. Whereas most of the costs of implementing the options are relatively well defined, the benefits from increased ecological services, in terms of recreation, residential, health, and nonuse values, are more difficult to quantify. As shown in Table 4-4, a new stated preference survey or revealed preference analysis (see Section 4.1.2) would likely be too costly to implement in this case; however, one practical alternative is to use a benefit transfer approach to approximate benefits. For example, a limited number of existing published studies have applied stated preference methods to assess the benefits of reducing AMD damage on streams in West Virginia and Pennsylvania (Collins et al., 2005; Farber and Griner, 2000). Although these studies address changes on different streams and for other populations, they may provide estimates of WTP that can be adapted or serve as approximations for the affected case study population. Similarly, a number of studies have estimated the monetary value of wetlands' benefits (see, for example, Woodward and Wui [2001], Brouwer et al. [1999] and Boyer and Polasky [2004]), which may provide useful approximations for the constructed wetlands option. Ideally, applying these types of benefit transfer approaches would involve experts in economics and aquatic ecosystems to ensure that the results from existing studies are properly interpreted and adapted to the case study context.

The effectiveness of this approach for understanding community preferences and comparing the costs and benefits of the two options depends importantly on how applicable and adaptable the benefits information is from existing studies. Since benefit transfers mean that preference information is drawn from different populations and/or water resource impairments, these differences should be accounted for either quantitatively (e.g., by adjusting the WTP estimates to better correspond to local conditions) or qualitatively (e.g., by describing the uncertainties and potential biases associated with transferring estimates). As discussed in Section 4.24, one of the possible limitations of benefit transfer is that community members may be less likely to accept benefit estimates that are derived from other areas or contexts, in which case it is especially important to address differences in populations and water resource impairments. It also may be the case that monetary estimates for certain subcategories of benefits (e.g., residential values) are not available in the literature. In these cases, it may be necessary to combine both quantitative and qualitative assessments of costs and benefits to evaluate the options (see, for example, Button et al. [1999]).

5.2.2. The CSO Case Study Example

Once the advisory committee has refined the conceptual models, the Basin Commission is in a position to assess community preferences for the two options. Because this example involves a large, multistate population with diverse stakeholder groups and interests, a combination of several methods likely would be used to determine overall community preference. This process likely will be an iterative one, conducted over a fairly long time frame to reach a final determination of community preferences.

If the commission determines that it is interested primarily in a sociocultural assessment of community preferences, then the public meetings and representative advisory committee that were used in framing the decision also can serve as the beginning of a sociocultural assessment process. In addition to gathering qualitative information from the community, these deliberative methods could be used to plan more extensive data collection and analysis efforts. For example, the advisory committee could help draft and develop a region-wide survey to elicit community preferences. As discussed in Chapter 4, a number of preference elicitation survey methods may be suitable for addressing the needs of the commission. For instance, as shown in Table 4-4, opinion or referendum surveys offer relatively less costly approaches that could be used to present the community with the main options under consideration and get structured feedback on preferences. Depending on the elicitation approach selected, a number of different survey administration methods are possible, including surveys that are mailed directly to sewer customers and local businesses, phone surveys, and surveys that are made available on a Web site. Alternatively, more complex and costly survey instruments that explore individuals' preferences regarding specific attributes of the options could be developed to support multiattribute trade-off analyses (see, for example, Gregory and Wellman [2001]) or conjoint analyses. For example, respondents could be presented with and asked to choose between management options that are characterized in several dimensions, including the numbers of river miles improved, the number of high-bacteria days avoided, the types of methods used to inform the public about high-bacteria conditions, and the annual costs of the options to local households. Although these multiattribute survey-based methods can provide rich characterizations of community preferences, as discussed in Sections 4.7 and 4.18, they also are relatively expensive because they require extensive pretesting and specialized technical expertise for designing and analyzing the survey.

If the commission is interested in conducting a BCA to evaluate the options, then several of the methods outlined in Chapter 4 are possible alternatives. The most direct approach would be to collect WTP information from the community using a stated preference approach, such as a contingent valuation (CV) survey.[2] These types of surveys also require specialized technical expertise for designing the instrument and analyzing the survey results; however, like opinion or

[2] A less direct approach would be to estimate benefits for specific aspects of the options separately. For example, recreation demand methods could be used to estimate recreation values and hedonic property methods used to estimate benefits for nearshore residents.

referendum surveys, they can be administered to households across the river basin using either phone, mail, Internet, or some combination of modes. A CV survey would, for example, present respondents with descriptions of one or more of the options under consideration. Ideally, these descriptions would include easily understandable information about current conditions—sources, stressors, aquatic ecosystem impacts, and ecosystem service impacts—and then describe how the option(s) would alter these impacts. In other words, it would convey much of the same information that is described in Figures 5-8 through 5-10 but not necessarily in the same format. The main objective of the CV survey would then be to elicit respondents' WTP for the options under consideration, using an appropriately designed elicitation technique.

The results of a stated preference survey like CV should provide decision-makers with estimates that can be used to evaluate not only the efficiency but also equity implications of different management options. For efficiency (benefit-cost) analysis, total benefit estimates for each option can be calculated by aggregating average (per respondent) WTP for each option across the population of interest (i.e., the population in the river basin). A stated preference survey also can inform an equity analysis by providing estimates of how benefits are distributed across the population. For example, the results may show whether and by how much average WTP is greater for populations who live closer to the river or who are more active recreational users of the river.

In addition to BCA, the commission might be interested in conducting an economic impact analysis (Section 4.25) of the options to estimate how they might affect economic activity in the region, in terms of industry-level revenues, employment levels, and household incomes. Although the results of this type of analysis would not directly support a BCA, they may nonetheless provide information to help policy makers understand the economic consequences of the options. In particular, they may provide information about the relative magnitudes and distributions of economic impacts across different sectors of the regional and local economy. The results of these analyses might be included as information in preference elicitation surveys of local residents to help respondents understand the expected economic consequences of different options.

5.3. SELECTING THE MANAGEMENT OPTION

The final step, as defined in Figure 5-1, is for the decision-makers to select the management option that best addresses their objectives, the communities' needs, and complies with the CWA and WQS regulation to attain the water body goal. The methods proposed in this report are intended to help decision-makers collect and organize information in a way that best supports these objective and needs. For example, in the AMD case study context, it is likely that a combination of quantitative measures and qualitative factors relating to water quality impairments, community preferences, and socioeconomic impacts will need to be considered in choosing between the constructed wetland and the limestone channel. If these assessments indicate that, in spite of the ecosystem services provided by the wetlands, the community has a strong preference for improving recreation services and eliminating as many miles of impairment along the river as possible, then the decision-makers may decide that the limestone channel is the best option. In the CSO case study context, it is likely that a more detailed and quantitative analysis will be feasible, which will allow for a more thorough assessment of the costs and benefits as well as the equity implications of the two options. For example, the analysis may indicate that the 95% reduction option (Option 1) will provide the higher level of net benefits (i.e., benefits minus costs). However, it may also show that the benefits are concentrated within a small sector of the population (i.e., those living in close proximity to the river) and that the rate increase required to pay for the option will impose a high burden on the lower-income segments of the community. Therefore, unless the rate increases can be redistributed, the decision-makers may decide that the 75% reduction option (Option 2) is the best option.

5.4. CONCLUSIONS

This chapter illustrated how the use of the methods and tools presented in the previous chapters can be implemented in order to support use-attainment decisions while complying with the CWA and WQS regulation. We developed a decision process framework to aid the development of a balanced analysis by revealing how the ecological and socioeconomic trade-offs can be understood, communicated, and weighed in the standard-setting process. A broader analysis—one that analyzes the ecological benefits—could provide important decision support.

The *Interim Economic Guidance* specifically states that the benefit-cost analysis is not required for determining widespread and substantial impacts (U.S. EPA, 1995). However, it explains that certain benefits may accrue to communities from cleaner water. Appendix C in the *Interim Economic Guidance* presents the types of benefits that could be relevant to a use-attainment decision, but it does not explain how to use the benefit estimates. We demonstrate an approach that could assist in determining which benefits to consider and how to use this information for evaluating and selecting a management option.

The purpose of this report is not to suggest the criteria that should be used in making any particular decision, rather it is to propose methods that could help decision-makers better frame and evaluate the options. None of the individual methods described in the report can determine unequivocally which management option is best suited to address a particular WQS issue. However, as we state in the goal of the report, they should enable states and authorized tribes—and the associated communities—to make informed decisions about their water bodies while remaining in the current regulatory framework.

Although the focus of this report is on use-attainment decisions, we believe that there are other opportunities to use this decision process framework. Community preferences could be important for prioritizing watershed-wide planning activities (e.g., see Figure 1-5). For example, the approach presented could improve grant proposals for water quality activities or assist in allocating restoration dollars to different projects in a watershed. Although we do not illustrate any of these examples in the report, we believe the three main phases of the decision process still apply. We suggest that water quality officials, watershed managers, members of stakeholder groups, and other interested individuals consider the importance of ecological benefits to addressing their objectives and the communities' needs and whether a balanced analysis could play an important role in supporting their particular watershed management decisions.

5.5. REFERENCES

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